

## Supplementary tables

Table S1. Questions in the CDR by domain and the response options with dummy coding

		<b>Question number</b>	<b>CDR question</b>	<b>CDR response options</b>
Community Affairs	study partner	Q1	Is the subject still working?	0=yes; 1=no
		Q2	Did memory or thinking problems contribute to the subject's decision to retire?	1=yes; 0=no
		Q3	Significant difficulty in job due to problems with memory and thinking?	0=rarely/never, 1=sometimes, 2=usually
		Q4a	Did he/she ever drive a car?	0=yes; 1=no
		Q4b	Does the subject drive a car now?	0=yes; 1=no
		Q4c	If no, is this because of memory/thinking problems?	1=yes, 0=no
		Q5	If he/she is still driving, are there problems or risks because of poor thinking?	1=yes, 0=no
		Q6	Is he/she able to independently shop for needs?	2=rarely/never; 1=sometimes; 0=usually
		Q7	Is he/she able to independently carry out activities outside the home?	2=rarely/never; 1=sometimes; 0=usually
		Q8	Is he/she taken to social functions outside a family home?	0=yes; 1=no
		Q9	Would a casual observer of the subject's behavior think the subject was ill?	1=yes; 0=no
Judgment and Problem Solving	study partner	Q1	In general, if you had to rate he/she abilities to solve problems at present time, would you rate them?	0=as good; 1=good, but not as good as before; 2=fair; 3=poor; 4=no ability at all
		Q2	Rate he/she ability to cope with small amounts of money	0=no loss; 1=some loss; 2= severe loss
		Q3	Rate he/she ability of handle complicated financial/business transactions	0=no loss; 1=some loss; 2= severe loss

	Q4	Can he/she handle a household emergency?	0=better than before; 1=as well as before; 2=worse than before due to trouble thinking
	Q5	Can he/she understand situations/explanations?	0=usually; 1=sometimes; 2=rarely
	Q6	Does he/she behave appropriately [i.e., in his/her usual (premorbid) manner] in social situations and interactions with other people?	0=usually; 1=sometimes; 2=rarely
study participant	Q1	How are these things alike? Turnip/Cauliflower	0=vegetable; 1=living things/can be cooked; 2=wrong
	Q2	How are these things alike? Desk/Bookcase	0=furniture, office furniture, hold books; 1=wooden, legs; 2=wrong
	Q3	What is the difference between these things? Lie/Mistake	0=one intentional, one deliberate; 1=one bad, one good, or explains only one thing; 2=wrong
	Q4	What is the difference between these things? River/Canal	0=natural - artificial; 1=anything else
	Q5	How many nickels in a dollar?	0=correct; 1=incorrect
	Q6	How many quarters in 6.75?	0=correct; 1=incorrect
	Q7	Subtract 3 from 20 and keep subtracting 3 from each new number all the way down	0=correct; 1=incorrect
	Q8	Upon arriving in a strange city, how would you locate a friend you wanted to see?	0=telephone book, courthouse, mutual friend; 1=call police/operator; 2=no clear response
	Q9	Subject's assessment of disability/station in life and understanding of why he/she is present at examination	0=good insight; 1=partial insight; 2=little insight

Memory	study partner	Q1 and Q1a	Does he/she have a problem with memory or thinking? Is this a consistent problem?	0=no problem; 1=inconsistent; 2=consistent
		Q2	Can he/she recall recent events	0=usually; 1=sometimes; 2=rarely
		Q3	Can he/she remember a short list of items (shopping)	0=usually; 1=sometimes; 2=rarely
		Q4	Has there been some decline in memory over the past year	1=yes; 0=no
		Q5	Is his/her memory impaired to a degree that it would have interfered with his/her daily life a few years ago?	1=yes; 0=no
		Q6	Does he/she completely forget a major event?	2=usually; 1=sometimes; 0=rarely
		Q7	Does he/she forget pertinent details for the major event?	2=usually; 1=sometimes; 0=rarely
		Q8	Does he/she completely forget important info from the distant past?	2=usually; 1=sometimes; 0=rarely
	study participant	Q1	Do you have problems with memory or thinking?	1=yes;0=no
		Q2	A few moments ago your (spouse, etc.) told me a few recent experiences you had. Will you tell me something about those? (autobiographical)	0=largely correct; 1; 2; 3; 4=largely incorrect
		Q4	When were you born?	0=correct; 1=incorrect
		Q5	Where were you born?	0=correct; 1=incorrect
		Q6a	What was the last school you attended (Name)?	0=correct; 1=incorrect
		Q6b	What was the last school you attended (Place)?	0=correct; 1=incorrect
Q6c	What was the last school you attended (grade)?	0=correct; 1=incorrect		

		Q7	What was your main occupation?	0=correct; 1=incorrect	
		Q8	What was your last major job?	0=correct; 1=incorrect	
		Q9	When did you retire and why?	0=correct; 1=incorrect	
		Q10	Repeat the name and address (John Brown 42 Market Street, Chicago)	0=all correct; 1=1 wrong; 2=2wrong; 3=3wrong;4=4wrong; 5=5wrong	
Orientation	study partner	Q1	How often does he/she know the exact date of the month?	0=usually; 1=sometimes; 2=rarely	
		Q2	How often does he/she know the exact month?	0=usually; 1=sometimes; 2=rarely	
		Q3	How often does he/she know the exact year?	0=usually; 1=sometimes; 2=rarely	
		Q4	How often does he/she know the exact day of the week?	0=usually; 1=sometimes; 2=rarely	
		Q5	Does he/she have difficulty with time relationships?	2=usually; 1=sometimes; 0=rarely	
		Q6	Can he/she find their way around familiar streets?	0=usually; 1=sometimes; 2=rarely	
		Q7	How often does he/she know how to get from place to place outside their neighborhood?	0=usually; 1=sometimes; 2=rarely	
		Q8	How often can he/she find their way about indoors?	0=usually; 1=sometimes; 2=rarely	
		study participant	Q1	What is the date today?	0=correct; 1=incorrect
			Q2	What day of the week is it?	0=correct; 1=incorrect

		Q3	What is the month?	0=correct; 1=incorrect
		Q4	What is the year?	0=correct; 1=incorrect
		Q5	What is the name of this place?	0=correct; 1=incorrect
		Q6	What town or city are we in?	0=correct; 1=incorrect
		Q7	What time is it?	0=correct; 1=incorrect
		Q8	Does the subject know who the informant is (in your judgement)?	0=correct; 1=incorrect
Personal Care	study partner	Q1	What is your estimate of he/she mental abilities: Dressing?	0=unaided; 1=occasionally bad; 2=commonly bad; 3=unable
		Q2	What is your estimate of he/she mental abilities: Washing/Grooming?	0=unaided; 1=occasionally bad; 2=commonly bad; 3=unable
		Q3	What is your estimate of he/she mental abilities: Eating habits?	0=unaided; 1=occasionally bad; 2=commonly bad; 3=unable
		Q4	What is your estimate of he/she mental abilities: Sphincter control?	0=unaided; 1=occasionally bad; 2=commonly bad; 3=unable

Table S2. Fit statistics for the confirmatory factor analysis

Domain	RMSEA	95% CI		TLI	CFI
Community Affairs	0.026	0.021	0.032	0.99	0.99
Judgment and Problem Solving	0.075	0.071	0.079	0.91	0.93
Memory	0.046	0.043	0.048	0.97	0.98
Orientation	0.059	0.056	0.062	0.97	0.97
Personal Care	0	0	0.035	1	1

RMSEA: root mean square error of approximation (lower is better); TLI: Tucker-Lewis index; CFI: comparative fit index. TLI and CFI close to 0.95 or higher indicates good fit.

Table S3. Item discrimination (a) and difficulty (b) parameters estimated from the unidimensional IRT model for each domain. Discrimination parameter indicates how well an item in discriminating participants with different degrees of dementia severity (higher is better). Difficulty parameter represents the degree of dementia severity at which certain response options have a 50% likelihood of being selected.

			a	b1	b2	b3	b4	b5
Community Affairs	study partner	Q1	1.007	-1.302				
		Q2	0.781	3.441				
		Q3	1.931	0.612	1.644			
		Q4a	1.251	3.220				
		Q4b	2.062	1.342				
		Q4c	0.593	-0.266				
		Q5	2.069	0.692				
		Q6	4.865	0.704	1.596			
		Q7	5.058	0.768	1.908			
		Q8	1.022	4.299				
		Q9	1.148	3.675				
Judgment and Problem Solving	study partner	Q1	3.519	-0.134	0.686	1.446	2.549	
		Q2	3.302	0.940	1.789			
		Q3	4.749	0.256	1.054			
		Q4	2.837	-2.882	0.818			
		Q5	2.029	0.977	2.323			
		Q6	1.138	2.316	4.854			
	study participant	Q1	1.271	1.450	2.759			
		Q2	1.452	1.514	2.094			
		Q3	1.575	1.187	1.885			
		Q4	0.889	0.369				
		Q5	1.623	1.718				
		Q6	1.695	0.719				
		Q7	1.599	0.742				
		Q8	1.434	1.742	2.703			
		Q9	2.346	0.826	1.892			
Memory	study partner	Q1 and Q1a	5.556	-0.170	0.062			
		Q2	3.534	0.447	1.415			
		Q3	2.935	-0.062	0.697			
		Q4	3.630	-0.173				
		Q5	4.358	0.262				
		Q6	3.354	1.281				

		Q7	3.676	0.439					
		Q8	1.666	0.873	2.225				
	study participant	Q1	0.998	-0.374					
		Q2	2.682	0.219	0.668	1.452	1.989		
		Q4	1.657	2.521					
		Q5	2.052	2.759					
		Q6a	1.884	2.155					
		Q6b	1.888	2.342					
		Q6c	1.796	2.626					
		Q7	2.265	2.504					
		Q8	2.291	1.897					
		Q9	1.996	0.918					
		Q10	1.934	-0.280	0.389	0.853	1.168	1.359	
Orientation		study partner	Q1	3.782	0.287	0.934			
			Q2	5.985	1.041	1.525			
	Q3		4.917	1.282	1.669				
	Q4		4.104	0.519	1.284				
	Q5		2.434	0.362	1.302				
	Q6		1.871	1.528	2.313				
	Q7		2.365	0.457	1.123				
	Q8		1.640	2.405	3.304				
	study participant	Q1	2.707	0.767					
		Q2	2.379	1.263					
		Q3	2.780	1.538					
		Q4	2.958	1.549					
		Q5	1.891	1.195					
		Q6	0.695	-0.071					
		Q7	1.333	1.711					
		Q8	0.951	5.928					
Personal care	study partner	Q1	3.933	1.521	2.799				
		Q2	2.709	1.572	3.005	4.164			
		Q3	2.266	2.362	4.581				
		Q4	1.550	2.915	3.967	5.436			

Table S4. Correlation between factors estimated from the bi-factor IRT model.

Correlation	General factor	Community Affair	Judgment and Problem Solving	Memory	Orientation	Personal Care
General factor	1	0	0	0	0	0
Community Affair		1	0.55	0.40	0.40	0.19
Judgment and Problem Solving			1	0.68	0.58	0.19
Memory				1	0.81	0.15
Orientation					1	0.17
Personal Care						1

Table S5. Item discrimination (a) and intercept (b) parameters estimated from the bi-factor IRT model. a1 and a2 are the discrimination parameters for the general factor and the domain specific factor, respectively. d1 to d5 are the intercepts corresponding to the boundaries of the response probabilities. Detailed presentation of the parameters for the multi-dimensional IRT model can be found in Reckase 2009 [1].

			a1	a2	d1	d2	d3	d4	d5
Community Affairs	study partner	Q3	2.682	-0.098	-1.303	-3.683			
		Q4c	0.649	0.264	0.064				
		Q5	1.855	0.467	-1.537				
		Q6	4.136	1.671	-3.564	-7.462			
		Q7	4.742	2.143	-4.472	-9.991			
Judgment and Problem Solving	study partner	Q1	3.772	0.713	0.486	-2.917	-5.779	-9.638	
		Q2	3.265	0.740	-3.454	-6.225			
		Q3	4.683	1.077	-1.490	-5.519			
		Q4	2.619	0.520	7.872	-2.414			
		Q5	2.076	0.360	-2.186	-4.938			
	study participant	Q1	0.923	1.264	-2.063	-3.908			
		Q2	1.078	1.369	-2.463	-3.408			
		Q3	1.140	1.567	-2.162	-3.443			
		Q5	1.162	1.562	-3.173				
		Q6	1.447	2.398	-1.699				
		Q7	1.221	1.763	-1.452				
		Q8	0.972	1.520	-2.871	-4.444			
		Q9	2.109	1.220	-2.145	-4.766			
Memory	study partner	Q1 and Q1a	4.622	0.363	0.843	-0.377			
		Q2	3.053	0.558	-1.584	-4.864			
		Q3	2.797	0.316	0.158	-2.188			



		Q4	3.408	0.196	0.611				
		Q5	3.941	0.500	-1.205				
		Q6	2.869	0.784	-4.289				
		Q7	3.128	0.480	-1.586				
		Q8	1.446	0.426	-1.469	-3.692			
	study participant	Q2	2.396	1.344	-0.611	-1.976	-4.288	-5.764	
		Q4	1.351	1.619	-4.979				
		Q5	1.604	1.492	-6.161				
		Q6a	1.435	2.139	-5.215				
		Q6b	1.579	1.969	-5.579				
		Q6c	1.380	1.817	-5.663				
		Q7	1.984	1.485	-6.302				
		Q8	1.989	1.502	-4.909				
		Q9	1.709	1.220	-2.027				
		Q10	1.869	1.565	0.652	-0.931	-2.053	-2.811	-3.260
Orientation	study partner	Q1	2.669	1.261	-1.005	-3.176			
		Q2	4.164	2.123	-5.520	-7.880			
		Q3	3.842	1.873	-6.095	-7.762			
		Q4	2.958	1.392	-1.991	-4.736			
		Q5	2.539	0.478	-1.084	-3.564			
		Q6	2.023	0.369	-3.190	-4.703			
		Q7	2.495	0.515	-1.323	-3.063			
		Q8	1.917	0.362	-4.434	-5.930			
	study participant	Q1	2.311	1.991	-2.456				
		Q2	2.015	1.512	-3.354				
		Q3	2.440	2.098	-5.106				
		Q4	2.786	2.663	-6.056				
		Q5	1.664	1.203	-2.534				
	Personal Care	study partner	Q1	3.210	2.307	-6.306	-10.864		
Q2			2.574	1.863	-5.023	-9.010	-12.191		
Q3			1.978	1.492	-5.764	-10.746			
Q4			1.267	1.026	-4.686	-6.317	-8.593		

Table S6. Factor loadings of the bi-factor IRT model with correlated domain specific factors. Factor loading is similar to correlation which represents the association between each an item and the factor.

			<b>General</b>	<b>Community Affair</b>	<b>Judgment and Problem Solving</b>	<b>Memory</b>	<b>Orientation</b>	<b>Personal Care</b>
<b>Community Affairs</b>	<b>Study partner</b>	Q3	0.84	-0.03	0	0	0	0
		Q4c	0.35	0.14	0	0	0	0
		Q5	0.73	0.18	0	0	0	0
		Q6	0.87	0.35	0	0	0	0
		Q7	0.87	0.39	0	0	0	0
<b>Judgment and Problem Solving</b>	<b>study partner</b>	Q1	0.90	0	0.17	0	0	0
		Q2	0.87	0	0.20	0	0	0
		Q3	0.92	0	0.21	0	0	0
		Q4	0.83	0	0.16	0	0	0
		Q5	0.77	0	0.13	0	0	0
	<b>study participants</b>	Q1	0.40	0	0.55	0	0	0
		Q2	0.44	0	0.56	0	0	0
		Q3	0.44	0	0.61	0	0	0
		Q5	0.45	0	0.60	0	0	0
		Q6	0.44	0	0.73	0	0	0
		Q7	0.45	0	0.64	0	0	0
		Q8	0.39	0	0.61	0	0	0
		Q9	0.71	0	0.41	0	0	0
		<b>Memory</b>	<b>study partner</b>	Q1 and Q1a	0.94	0	0	0.07
Q2	0.86			0	0	0.16	0	0
Q3	0.85			0	0	0.10	0	0
Q4	0.89			0	0	0.05	0	0
Q5	0.91			0	0	0.12	0	0
Q6	0.84			0	0	0.23	0	0
Q7	0.87			0	0	0.13	0	0
Q8	0.64			0	0	0.19	0	0
<b>study participants</b>	Q2		0.74	0	0	0.42	0	0
	Q4		0.50	0	0	0.60	0	0
	Q5		0.58	0	0	0.54	0	0
	Q6a		0.47	0	0	0.69	0	0
	Q6b		0.52	0	0	0.65	0	0
	Q6c		0.49	0	0	0.64	0	0
	Q7		0.66	0	0	0.49	0	0

		Q8	0.66	0	0	0.50	0	0
		Q9	0.63	0	0	0.45	0	0
		Q10	0.63	0	0	0.53	0	0
<b>Orientation</b>	<b>study partner</b>	Q1	0.78	0	0	0	0.37	0
		Q2	0.84	0	0	0	0.43	0
		Q3	0.84	0	0	0	0.41	0
		Q4	0.80	0	0	0	0.38	0
		Q5	0.82	0	0	0	0.15	0
		Q6	0.76	0	0	0	0.14	0
		Q7	0.81	0	0	0	0.17	0
		Q8	0.74	0	0	0	0.14	0
	<b>study participants</b>	Q1	0.66	0	0	0	0.57	0
		Q2	0.66	0	0	0	0.50	0
		Q3	0.67	0	0	0	0.58	0
		Q4	0.66	0	0	0	0.63	0
		Q5	0.62	0	0	0	0.45	0
<b>Personal care</b>	<b>study participants</b>	Q1	0.75	0	0	0	0	0.54
		Q2	0.71	0	0	0	0	0.52
		Q3	0.66	0	0	0	0	0.50
		Q4	0.54	0	0	0	0	0.44

#### Reference

[1] Reckase MD. Multidimensional item response theory models. Multidimensional item response theory: Springer; 2009. p. 79-112.